PATENT SPECIFICATION 713,258

Inventor:—ROBERT ROY.

Date of filing Complete Specification : June 11, 1952.

Application Date : June 11, 1951. No. 13836/51.

Complete Specification Published : Aug. 11, 1954.

Index at Acceptance :—Classes 4, G8B; and 65(1), A(2E : 6).

COMPLETE SPECIFICATION.

Improvements in or relating to Mechanisms for Opening and Closing Doors.

We, THE BRISTOL AEROPLANE COMPANY LIMITED, a British Company, of Stock Exchange Buildings, St. Nicholas Street, in the City and County of Bristol, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to mechanisms for opening and closing doors in the skin of a structural shell to permit the extension and retraction of auxiliary equipment. Such doors are necessary for example in aircraft structures to enable landing gear to be extended and retracted, and the invention is concerned primarily, but not necessarily exclusively, with such use, since similar conditions arise in other fields, for example retractable hoods for motor vehicles and retracable gear for water-borne and submarine craft.

More particularly the invention is applied to an arrangement of the kind (hereinafter referred to as of the "kind set forth") in which two or more doors which together close an opening in the skin through which the auxiliary equipment is extened and re- the auxiliary equipment is extended and retracted are mechanically connected to the actuated during the extension and retraction thereof, the arrangement being such that during extension of the equipment at least one of the doors opens and closes again by the time the equipment is fully extended. In the case of an aircraft the advantage of such an arrangement is that during take-off and landing the aerodynamic drag of the open landing gear bay is minimised, and the entry of dust and mud is largely prevented.

[*Price* 2*s.* 8*d.*]

In a known aircraft landing gear arrangement of the kind set forth which is required to be opened and closed again during the extension of the gear is connected by a link to one arm of a bell-crank lever arranged so that the link and lever are in dead-centre relation when the door is fully open, the other arm of the bell-crank being connected by a second link to a part of the gear swinging about a fixed centre.

This mechanism allows only a limited control of the relation between the travel of the gear and the opening of the door, and practical cases arise in which limitations of space within the landing gear bay and of clearance from external parts such as wing flaps preclude the use of the mechansm in its simple form.

The object of the present invention is to provide an improved mechanism which will be readily adaptable for use with various arrangements of retractable equipment and which will permit the rates of opening and closing of the doors in relation to movement of the equipment, and the extent of such opening, to be closely controlled.

In its broadest aspect the invention provides mechanism for opening and closing doors in the skin of a structural shell to permit the extension and retraction of auxiliary equipment, said mechanism comprising a cam mechanism, preferably of the positive action type, in series with a dead-centre mechanism for the operation of a door which opens and closes again during the extension of the retractable equipment.

By a "dead-centre" mechanism is meant any mechanism comprising a link one end of which is moved along a locus such that for passage of the said end in one direction along the locus the other end moves first in

BEST AVAILABLE COPY

one direction along its own locus and then in the opposite direction. By a "positive action cam mechanism" is meant a mechanism comprising a sliding or rolling follower co-operating with complementary cam surfaces so as to obviate the use of return springs or the like.

According to features of the invention the cam mechanism may be arranged either before or after the dead-centre mechanism in the line of transmission from the retractable equipment to the door, and in the former case the same cam mechanism may be used to operate a door which remains open when the equipment is fully extended.

In one arrangement according to the invention a door which opens and closes again by the time the retractable equipment is fully extended is connected to a pivoted member having guide surfaces engaged by a sliding or rolling operating member carried by a crank connected by a link to a second crank so connected to the retractable equipment as to move through a dead-centre position with respect to the link during extension and rectraction of the equipment, the said dead-centre position occurring when the door is fully open.

In cases in which over-opening of the door is not permissible it may be advantageous to arrange for the door to be locked stationary in its fully open position while the retractable equipment continues to move, and for this purpose the guide surfaces of the pivoted member referred to in the preceding paragraph may be in part at constant radius with respect to the axis of the co-operating crank when the door is in its fully open position.

According to further features of the invention the operating member engages a slot, which may be straight, in the pivoted member to effect the opening and closing movements of the door and is free from the said slot during the part of the retraction and extension movements of the gear occurring while the door is fully open, the door being locked during this period by the engagement of the operating member or other parts carried by its crank with surfaces on the pivoted member having constant radius with respect to the axis of the crank.

A constructional example of an aircraft undercarriage arranged to retract into an engine nacelle and embodying certain features of the invention is shown in the drawings filed with the Provisional Specification and also in the accompanying drawings, in which:—

Figure 5 is a plan view of the mechanism of Figure 1 of the drawings filed with the Provisional Specification and to a larger size;

Figure 6 is a side elevation showing certain details of construction of the mechanism, to a larger size, not illustrated in Figure 1; and

Figure 7 is a plan view of the mechanism of Figure 6.

Referring to Figure 1, the undercarriage comprises an oleo leg 1 having fork arms 2 at its upper end connected to the airframe structure by pivots 3. The lower, movable, part 4 of the oleo leg is hinged at 5 to a four wheeled bogie 6. The bogie is held locked in its operative position by a jack 7 which also serves to turn it in an anticlockwise direction about the pivot 5 as the first phase of the retraction process, a damper 8 then passing over dead-centre and holding the bogie in the turned position. When in the extended position, the oleo leg is located by an extensible radius rod 9 connected to the airframe structure by a pivot 10. The radius rod contains a locking mechanism to lock the undercarriage in the down position. Retraction of the undercarriage is effected by a jack 11 operating between a bracket 12 on the fixed part of the oleo leg and a pivot 13 carried by the airframe structure. The retracted position of the undercarriage is indicated by chain dotted lines, an up-lock pin 14 carried by the bracket 12 then engaging a bracket (not shown) mounted on the structure.

The undercarriage bay is closed by three pairs of doors opening outwardly. The forward pair, which are shown at 15, are narrow doors pivoted about hinge lines 16 and sufficiently wide to allow for the passage of the radius rod 9.

The pivot shaft 10, which is connected to the radius rod 9 for rotation thereby during extension and retraction of the undercarriage, carries an upstanding arm 50 (see Figure 6) the tip 51 of which engages a block 52 carried in a slidably mounted end piece 53 of a rod 54 which passes into a telescopic cylinder 55 containing a spring 56. The upper end of the cylinder 55, as shown in Figure 6 is connected by a link 57 and a bell crank lever 58 with an arm 59 which is connected, at 60, to the door 15. The cylinder 55 is supported by brackets 61 from the aircraft structure. The spring 56 acts through cylinder 55, link 57 and arms 58, 59 to open the doors 15. When the undercarriage is fully extended spring 56 has opened doors 15 and the tip 51 has been adjusted through pivot shaft 10 and rod 9 so that it stands some distance clear of the block 52 (to the right thereof in Figure 6). During the first part of the retracting movement of the undercarriage the tip 51 is brought into engagement with the block 52 (i.e. there is a lost motion) and thereafter, during the second part of the retracting movement, the upstanding arm 50 moves rod 54 to compress spring 56 and thereby close the doors 15.

For the passage of the oleo leg and bogie there are provided a pair of wide doors 17 pivoted about hinge lines 18 and a pair of rear doors 19 pivoted about hinge lines 20. It is to be understood that as regards the doors, in Figures 1 and 6 of the drawing only the doors on the far side of the central vertical plane of the nacelle are shown. Since the undercarriage is entirely clear of the doors 19 when lowered (Figure 1) it is then possible to close these doors and thereby reduce the aerodynamic drag and prevent the entry of dust and spray thrown up by the wheels.

Both pairs of doors 17 and 19 are operated from crankpins 21 on the arms of the oleo leg fork through mechanism arranged at the sides of the undercarriage bay, only the mechanism on the right hand side, for the right hand doors, being shown in the drawing (Figure 2). This mechanism comprises a rocking shaft 22 journalled in stationary bearings and carrying three lever arms 23, 24 and 25 connected by links 26, 27 and 28 respectively to the crank pin 21, a driving crank 29 pertaining to a cambox 30 and a driving crank 31 pertaining to a cambox 32. The cambox 30 has a driven crank 33 connected by a link 34 (diagrammatically represented in Figure 5 by chain lines) to a lever arm 35 secured to the door 17, while the cambox 32 similarly has a driven crank 36 connected by a link 37 to a lever arm 38 secured to the door 19. When the undercarriage is fully down, as shown, the door 17 is open, while the door 19 is closed; retraction of the undercarriage moves the lever 25 from the position shown in full lines to the position 25^1 shown in broken lines (Figure 1), and it will be observed that in doing so the lever 25 passes through a dead-centre position in which it is in alignment with the link 28, so that the cambox lever 31, and with it the driven lever 36, reciprocates from the door-closed position shown, through the door-open position and back to the door-closed position. The lever 24 on the other hand does not pass through a dead-centre position with respect to the link 27, so that on undercarriage retraction the door 17 moves in one direction only, namely to the closed position. The purpose of the camboxes 30 and 32 is to adjust the velocity ratio of each mechanism so that the doors clear the undercarriage in all positions and also the wing flaps, which approach closely on each side of the nacelle. The camboxes are also arranged to lock the doors securely in their open positions.

Figure 2 is a view of the cambox 32 with the lever 31 and one of the side plates removed to show the internal parts. The lever 31 is secured to a shaft 39 journalled in the sides of the box and carrying a crank composed of two side plates 40 (the upper one being omitted from the drawing) spaced apart by a sector plate 41 and carrying an operating member formed by a crankpin 42. The crankpin 42 is pivotally mounted between the side plates 40 and is a clearance fit in a slot 43 formed in a cam lever 44 carried by trunnions 45 journalled in the side plates of the box.

The crankpin 42 accordingly rolls in the slot 43 along that side of the slot from which load is applied. Instead of the crankpin 42, the operating member may take the form of a pivotal block sliding in the slot 43. The arm 36 of the cam lever is connected to the door 19 as shown in Figure 1. The parts are shown in the door-closed position and it will be seen that the crankpin 42 is near the inner end of the slot 43, in which position the velocity ratio of the mechanism is a maximum so that quick opening and closing movements of the door are obtained. The positions of the crank 40 and cam lever 44 shown in chain-dotted lines correspond to the fully open position door 19, the crankpin 42 having come to the end of the slot 43, while the cam lever and sector plate 41 have rolled together so that they overlap. When in this position a guide surface 46 of the cam lever is at constant radius with respect to the shaft 39 so that the cam lever is held stationary but the shaft can continue to rotate. An extension 47 of the cam lever is suitably shaped to allow this action to take place and to secure a gradual transition of the locking action to the sector plate as the latter becomes sufficiently engaged for this purpose. In this way over-opening of the doors, which would result from the necessarily high starting velocity ratio, is avoided and the wing flaps can be extended more closely up to the nacelle.

The relationship between undercarriage movement and door movement for a particular aircraft is illustrated graphically on Figure 3 in which percentages of door opening are plotted as ordinates against percentage of undercarriage extension. The origin at the bottom left hand corner accordingly corresponds to the fully retracted position with the doors 19 closed, while at the right hand end the undercarriage is fully extended. It will be noted that the diagram has been shortened by the omission of part of the parallel centre section. The curve B shows the door opening angles necessary to provide a minimum safe clearance between all parts of the undercarriage and the doors 19, and it will be seen that the doors are required to open fully during the first 14% of the undercarriage extension movement and close again during the last 20% of the movement. This is the minimum requirement, and the curve C of the actual door movement shows that the mechanism described with reference to Figures 1 to 5 comfortably ex-

ceeds this requirement without either imposing an unnecessarily high velocity ratio at any stage of operation or causing over-opening of the doors. The mechanism also has the merits of simple construction and independence of the geometry of the undercarriage linkage, so that it is adaptable for use with various types of undercarriage. It is also independent of stress deflections and backlash in the undercarriage mechanism so that movement of the doors to a well defined closed position can be relied upon.

The cambox 30 is of similar construction to that of the box 32, that is to say it contains a crank and slot mechanism providing rapid opening of the doors followed by a dwell period in which the doors are locked open by a sector plate such as 41, the dimensions and shape of the parts are however selected according to the different characteristics required in this case. These characteristics, for the same aircraft as was referred to in connection with Figure 3 are shown in Figure 4, and in this case the minimum clearance line D shows that at 14% undercarriage extension the doors have to be 85% open, and fully open at 30% extension. The actual characteristic obtained is shown by the line E, the doors being fully open at 14% extension and then remaining locked in the open position.

In the arrangement described the doors 17 which remain open in the undercarriage down position and the doors 19 which close again by the time this position is reached are operated through separate cam mechanisms, the camboxes 32 pertaining to the doors 19 being arranged after their dead-centre mechanisms, but this arrangement is not necessarily essential since the camboxes 30 pertaining to the doors 17 might be provided each with a driven crank arm arranged to move in dead-centre relation to a link operating one of the doors 19 through a simple bell crank system, the cam boxes pertaining to the doors 19 then being arranged before their dead-centre mechanisms. Such an arrangement would be applicable in a case in which over-opening of the doors 17 or earlier closing of the doors 19 is permissible.

What we claim is:—

1. Mechanism for opening and closing doors in the skin of a structural shell to permit the extension and retraction of auxiliary equipment, said mechanism comprising a cam mechanism in series with a dead-centre mechanism (as previously defined) for the operation of a door which opens and closes again during the extension of the retractable equipment.

2. Mechanism of the kind set forth for opening and closing doors in aircraft structures to enable landing gear to be extended and retracted, said mechanism comprising a cam mechanism in series with a dead-centre mechanism (as previously defined) for the operation of the door which opens and closes again during the extension of the retractable equipment.

3. Mechanism according to Claim 1 or 2 wherein the cam mechanism is of the positive action type as hereinbefore defined.

4. Mechanism as claimed in Claim 1, 2 or 3 in which the cam mechanism is arranged after the dead-centre mechanism in the line of transmission from the retractable equipment to the door.

5. Mechanism as claimed in Claim 1, 2 or 3 in which the cam mechanism is arranged before the ded-centre mechanism in the line of transmission from the retractable equipment to the door.

6. Mechanism as claimed in Claim 5 wherein the cam mechanism additionally operates a door which remains open when the equipment is fully extended.

7. Mechanism as claimed in any preceding claim is which the door which opens and closes again during the extension of the retractable equipment is connected to a pivoted member having guide surfaces engaged by a sliding or rolling operating member carried by a crank connected by a link to a second crank so connected to the retractable equipment as to move through a dead-centre position with respect to the link during extension and retraction of the equipment, the said dead-centre position occurring when the door is fully open.

8. Mechanism as claimed in any preceding claim in which the door which opens and closes during the extension of the retractable equipment is locked stationary in its fully open position while the retractable equipment continues to move.

9. Mechanism according to Claims 7 and 8 in which the guide surfaces of said pivoted member are in part at constant radius with respect to the axis of the co-operating crank when the door is in its fully open position.

10. Mechanism as claimed in Claim 7 or any claim appendant thereto in which the operating member engages a slot in the pivoted member to effect the opening and closing movements of the door and is free from the said slot during the part of the retraction and extension movements of the gear occurring while the door is fully open, the door being locked during this period by the engagement of the operating member or other parts carried by its crank with surfaces on the pivoted member having constant radius with respect to the axis of the crank.

11. Mechanism for opening and closing doors in the skin of a structural shell to permit the extension and retraction of auxiliary equipment substantially as herein-

before described with reference to, and as illustrated in Figures 1 and 2 of the drawings filed with the Provisional Specification and Figures 5, 6 and 7 of the accompanying drawings.

BOULT, WADE & TENNANT,
111 & 112 Hatton Garden,
London, E.C.1.
Chartered Patent Agents.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Mechanisms for Opening and Closing Doors.

We, THE BRISTOL AEROPLANE COMPANY LIMITED, a British Company, of Stock Exchange Buildings, St. Nicholas Street, in the City and County of Bristol, do hereby declare this invention to be described in the following statement:—

This invention relates to mechanisms for opening and closing doors in the skin of a structural shell to permit the extension and retraction of auxiliary equipment. Such doors are necessary for example in aircraft structures to enable landing gear to be extended and retracted, and the invention is concerned primarily, but not necessarily exclusively, with such use, since similar conditions arise in other fields, for example retractable hoods for motor vehicles and retractable gear for water-borne and submarine craft.

More particularly the invention relates to an arrangement of the kind in which two or more doors which together close an opening in the skin through which the auxiliary equipment is extended and retracted are mechanically connected to the auxiliary equipment so as to be positively actuated during the extension and retraction thereof, the arrangement being such that during extension of the equipment at least one of the doors opens and closes again by the time the equipment is fully extended. In the case of an aircraft the advantage of such an arrangement is that during take-off and landing the aerodynamic drag of the open landing gear bay is minimised, and the entry of dust and mud is largely prevented.

In a known aircraft landing gear arrangement of this kind a door which is required to be opened and closed again during the extension of the gear is connected by a link to one arm of a bell-crank lever arranged so that the link and lever are in dead-centre relation when the door is fully open, the other arm of the bell-crank being connected by a second link to a part of the gear swinging about a fixed centre.

This mechanism allows only a limited control of the relation between the travel of the gear and the opening of the door, and practical cases arise in which limitations of space within the landing gear bay and of clearance from external parts such as wing flaps preclude the use of the mechanism in its simple form.

The object of the present invention is to provide an improved mechanism which will be readily adaptable for use with various arrangements of retractable equipment and which will permit the rates of opening and closing of the doors in relation to movement of the equipment, and the extent of such opening, to be closely controlled.

In its broadest aspect the invention consists in the use, in an arrangement of the kind described, of a cam mechanism, preferably of the positive action type, in series with a dead-centre mechanism for the operation of a door which opens and closes again during the extension of the retractable equipment.

By a "dead-centre" mechanism is meant any mechanism comprising a link one end of which is moved along a locus such that for passage of the said end in one direction along the locus the other end moves first in one direction along its own locus and then in the opposite direction. By a "positive action cam mechanism" is meant a mechanism comprising a sliding or rolling follower co-operating with complementary cam surfaces so as to obviate the use of return springs or the like.

According to features of the invention the cam mechanism may be arranged either before or after the dead-centre mechanism in the line of transmission from the retractable equipment to the door, and in the former case the same cam mechanism may be used to operate a door which remains open when the equipment is fully extended.

In one arrangement according to the invention a door which opens and closes again by the time the retractable equipment is fully extended is connected to a pivoted member having guide surfaces engaged by a sliding or rolling operating member carried by a crank connected by a link to a second crank so connected to the retractable equipment as to move through a dead-centre position with respect to the link during extension and retraction of the equipment, the said dead-centre position occurring when the door is fully open.

In cases in which over-opening of the door is not permissible it may be advantageous to arrange for the door to be locked stationary in its fully open position while the retractable equipment continues to move, and for this purpose the guide surfaces of the pivoted member referred to in the preceding paragraph may be in part at constant radius with respect to the axis of the co-operating crank when the door is in its fully open position.

According to further features of the invention the operating member engages a slot, which may be straight, in the pivoted member to effect the opening and closing movements of the door and is free from the said slot during the part of the retraction and extension movements of the gear occurring while the door is fully open, the door being locked during this period by the engagement of the operating member or other parts carried by its crank with surfaces on the pivoted member having constant radius with respect to the axis of the crank.

A constructional example of an aircraft undercarriage arranged to retract into an engine nacelle and embodying certain features of the invention is shown in the accompanying drawings, in which:—

Figure 1 is a general view of the arrangement in side elevation;

Figure 2 shows details of the cam mechanism to a larger scale; and

Figures 3 and 4 show graphically the relation between the movements of the undercarriage and the doors.

Referring to Figure 1, the undercarriage comprises an oleo leg 1 having fork arms 2 at its upper end connected to the airframe structure by pivots 3. The lower, movable, part 4 of the oleo leg is hinged at 5 to a four wheeled bogie 6. The bogie is held locked in its operative position by a jack 7 which also serves to turn it in an anticlockwise direction about the pivot 5 as the first phase of the retraction process, a damper 8 then passing over dead-centre and holding the bogie in the turned position. When in the extended position, the oleo leg is located by an extensible radius rod 9 connected to the airframe structure by a pivot 10. The radius rod contains a locking mechanism to lock the undercarriarge in the down position. Retraction of the undercarriage is effected by a jack 11 operating between a bracket 12 on the fixed part of the oleo leg and a pivot 13 carried by the airframe structure. The retracted position of the undercarriage is indicated by broken lines, an up-lock 14 carried by the bracket 12 then engaging a bracket (not shown) mounted on the structure.

The undercarriage bay is closed by three pairs of doors opening outwardly. Part of the forward pair are shown at 15. These are narrow doors pivoted about hinge lines 16 and sufficiently wide to allow for the passage of the radius rod 9. The doors 15 are opened as the undercarriage is lowered by means of cranks on the pivot shaft 10 and suitable intermediate linkage, these parts not being shown on the drawing.

For the passage of the oleo leg and bogie there are provided a pair of wide doors 17 pivoted about hinge lines 18 and a pair of narrow rear doors 19 pivoted about hinge lines 20. It is to be understood that as regards the doors the drawing is diagrammatic and that only the doors on the far side of the central vertical plane of the nacelle are shown. Since the undercarriage is entirely clear of the doors 19 when lowered it is then possible to close these doors and thereby reduce the aerodynamic drag and prevent the entry of dust and spray thrown up the wheels.

Both pairs of doors 17 and 19 are operated from crankpins 21 on the arms of the oleo leg fork through mechanism arranged at the sides of the undercarriage bay, only the mechanism on the right hand side, for the right hand doors, being shown in the drawing. This mechanism comprises a rocking shaft 22 journalled in stationary bearings and carrying three lever arms 23, 24 and 25 connected by links 26, 27 and 28 respectively to the crank pin 21, a driving crank 29 pertaining to a cambox 30 and a driving crank 31 pertaining to a cambox 32. The cambox 30 has a driven crank 33 connected by a link 34 to a lever arm 35 secured to the door 17, while the cambox 32 similarly has a driven crank 36 connected by a link 37 to a lever arm 38 secured to the door 19. When the undercarriage is fully down, as shown, the door 17 is open, while the door 19 is closed; retraction of the undercarriage moves the lever 25 from the position shown in full lines to the position 25^1 shown in broken lines, and it will be observed that in doing so the lever 25 passes through a dead-centre position in which it is in alignment with the link 28, so that the cambox lever 31, and with it the driven lever 36, reciprocates from the door-closed position shown, through the door-open position and back to the door-closed position. The lever 24 on the other hand does not pass through a dead-centre position with respect to the link 27, so that the door 17 moves in one direction only, namely to the closed position. The purpose of the camboxes 30 and 32 is to adjust the velocity ratio of each mechanism so that the doors clear the undercarriage in all positions and also the wing flaps, which approach closely on each side of the nacelle. The camboxes are also arranged to lock the doors securely in their open positions.

Figure 2 is a view of the cambox 32 with the lever 31 and one of the side plates re-

moved to show the internal parts. The lever 31 is secured to a shaft 39 journalled in the sides of the box and carrying a crank composed of two side plates 40 (the upper one being omitted from the drawing) spaced apart by a sector plate 41 and carrying a crankpin 42. The crankpin rolls in a slot 43 formed in a cam lever 44 carried by trunnions 45 journalled in the side plates of the box. The arm 36 of the cam lever is connected to the door 19 as shown in Figure 1. The parts are shown in the door-closed position and it will be seen that the crankpin 42 is near the inner end of the slot 43, in which position the velocity ratio of the mechanism is a maximum, so that quick opening and closing movements of the door are obtained. The positions of the crank 40 and cam lever 44 shown in chain-dotted lines correspond to the fully open position of the door 19, the crankpin 42 having come to the end of the slot 43, while the cam lever and sector plate 41 have rolled together so that they overlap by the amount A. When in this position the guide surface 46 of the cam lever is at constant radius with respect to the shaft 39 so that the cam lever is held stationary but the shaft can continue to rotate. The extension 47 of the cam lever is suitably shaped to allow this action to take place and to secure a gradual transition of the locking action to the sector plate as the latter becomes sufficiently engaged for this purpose. In this way over-opening of the doors, which would result from the necessarily high starting velocity ratio, is avoided and the wing flaps can be extended more closely up to the nacelle.

The relationship between undercarriage movement and door movement for a particular aircraft is illustrated graphically on Figure 3 in which degrees of door opening are plotted as ordinates against percentage of undercarriage extension. The origin at the bottom left hand corner accordingly corresponds to the fully retracted position with the doors 19 closed, while at the right hand end the undercarriage is fully extended. It will be noted that the diagram has been shortened by the omission of part of the parallel centre section. The curve B shows the door opening angles necessary to provide a minimum safe clearance between all parts of the undercarriage and the door 19, and it will be seen that the doors are required to open fully during the first 14% of the undercarriage extension movement and close again during the last 20% of the movement. This is the minimum requirement, and the curve C of the actual door movement shows that the mechanism described with reference to Figures 1 and 2 comfortably exceeds this requirement without either imposing an unnecessarily high velocity ratio at any stage of operation or causing over-opening of the doors. The mechanism also has the merits of simple construction and independence of the geometry of the undercarriage linkage, so that it is adaptable for use with various types of undercarriage. It is also independent of stress deflections and backlash in the undercarriage mechanism so that movement of the doors to a well defined closed position can be relied upon.

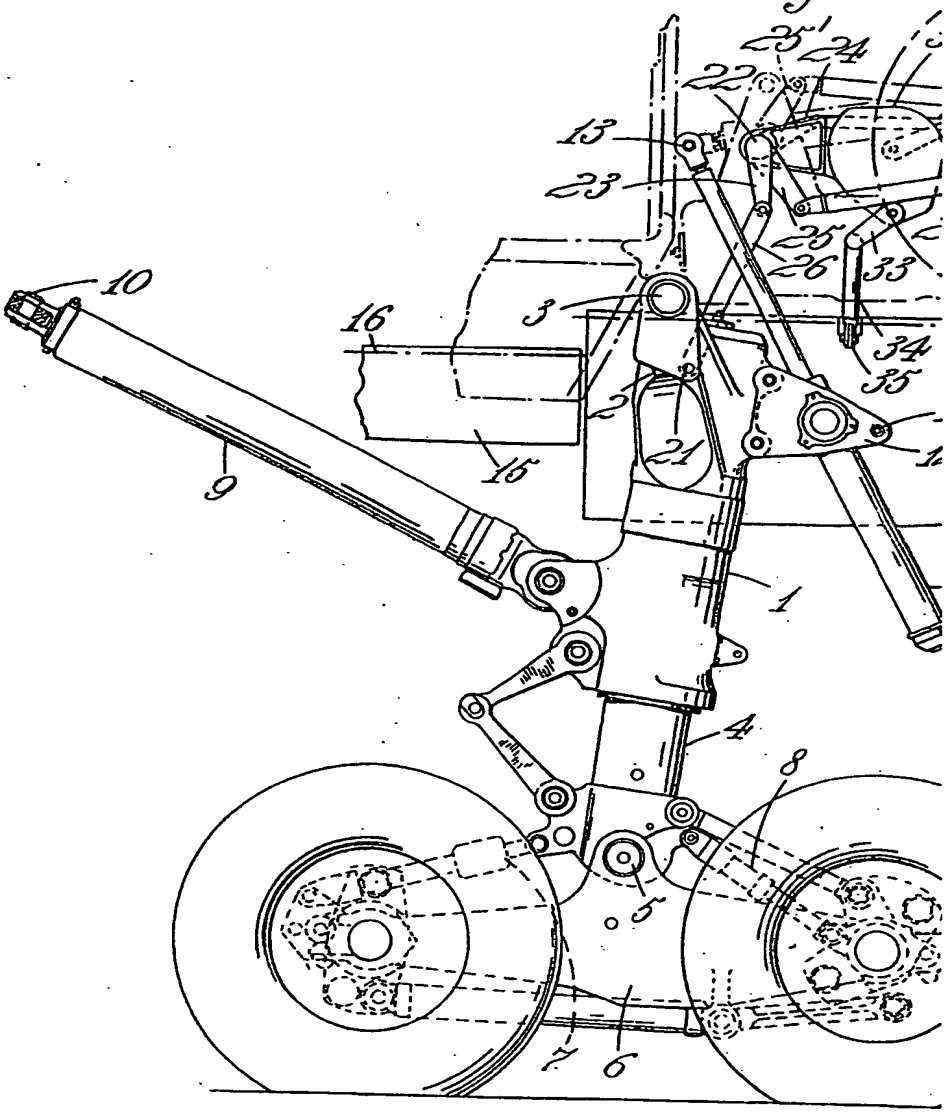
The cambox 30 is of similar construction to that of the box 32, that is to say it contains a crank and slot mechanism providing rapid opening of the doors followed by a dwell period in which the doors are locked open by a sector plate such as 41, the dimensions and shape of the parts are however selected according to the different characteristics required in this case. These characteristics, for the same aircraft as was referred to in connection with Figure 3 are shown in Figure 4, and in this case the minimum clearance line D shows that at 14% undercarriage extension the doors have to be 85% open, and fully open at 30% extension. The actual characteristic obtained is shown by the line E, the doors being fully open at 14% extension and then remaining locked in the open position.

In the arrangement described the doors 17 which remain open in the undercarriage down position and the doors 19 which close again by the time this position is reached are operated through separate cam mechanism, but this arrangement is not necessarily essential since the cambox 30 might be provided with a driven crank arm arranged to move in dead-centre relation to a link operating the door 19 through a simple bell crank system. Such an arrangement would be applicable in a case in which over-opening of the doors 17 or earlier closing of the doors 19 is permissible.

BOULT, WADE & TENNANT,
111 & 112 Hatton Garden,
London, E.C.1.
Chartered Patent Agents.

Abingdon: Printed for Her Majesty's Stationery Office, by Burgess & Son (Abingdon), Ltd.—1954.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2,
from which copies may be obtained.

Fig. 1.



713,258 PROVISIONAL SPECIFICATION

2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEET 1

Fig. 1.

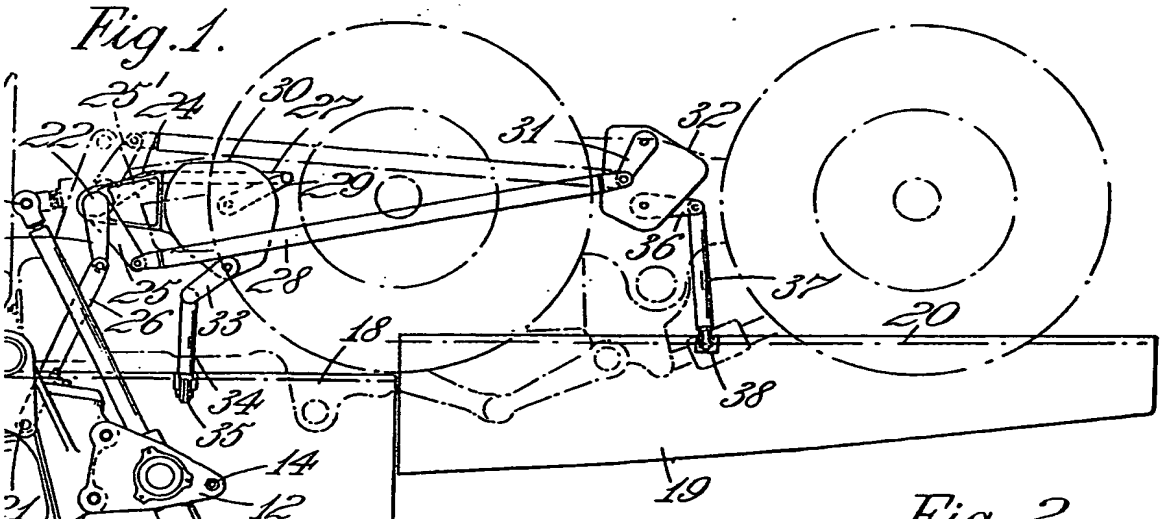
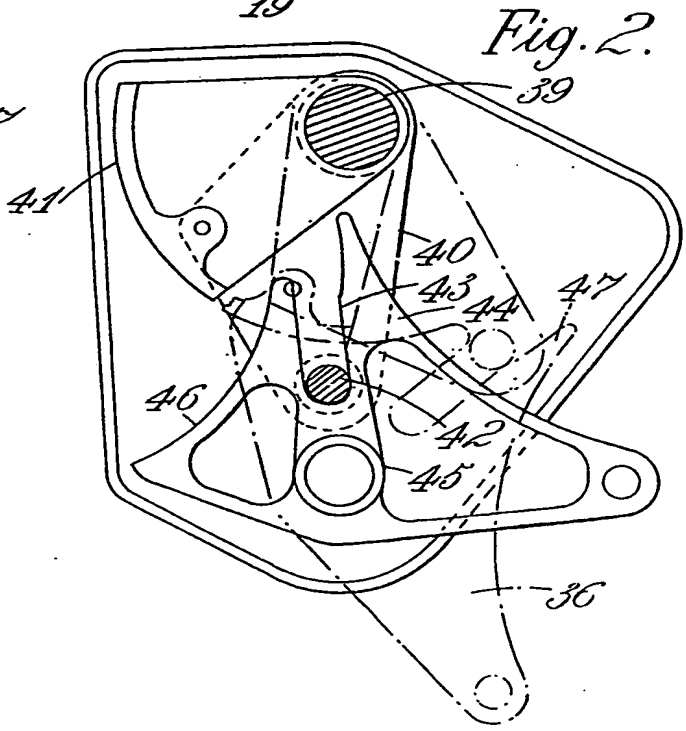
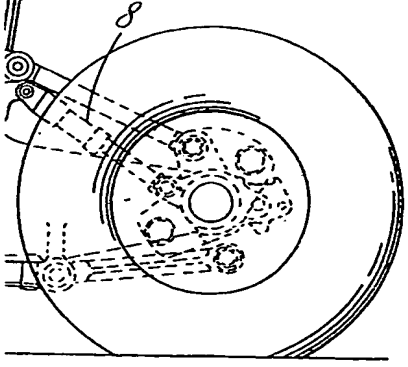


Fig. 2.





713,258 PROVISIONAL SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

SHEET 1

Fig. 1.

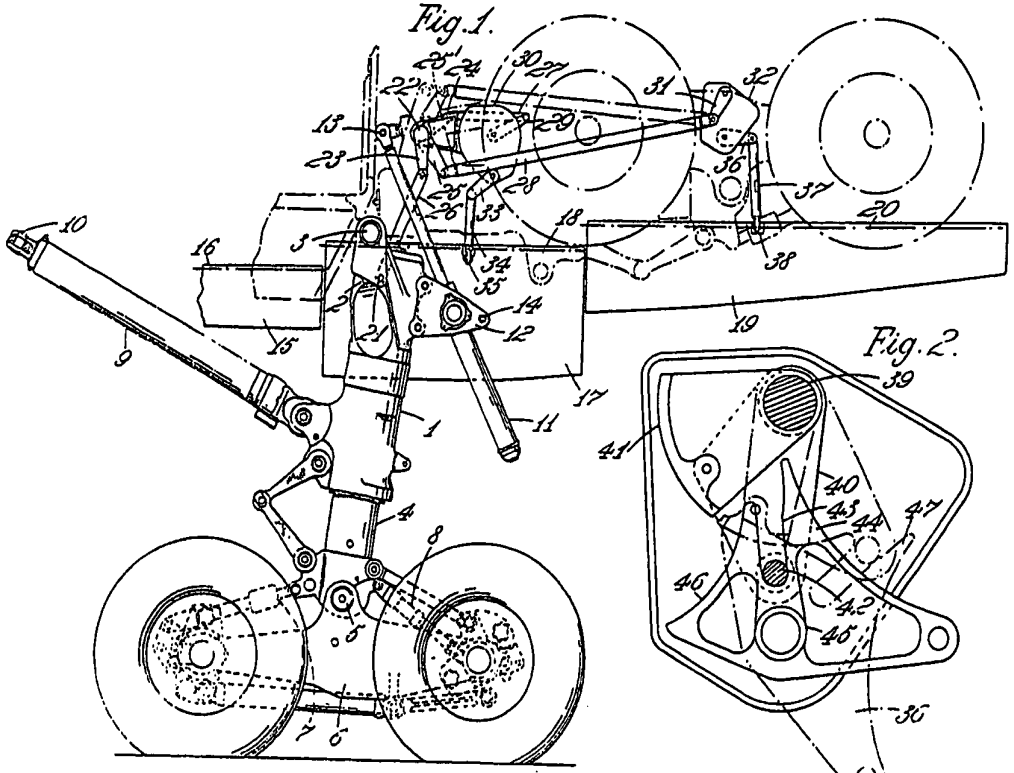


Fig. 2.

713,258 PROVISIONAL SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

Fig. 3.

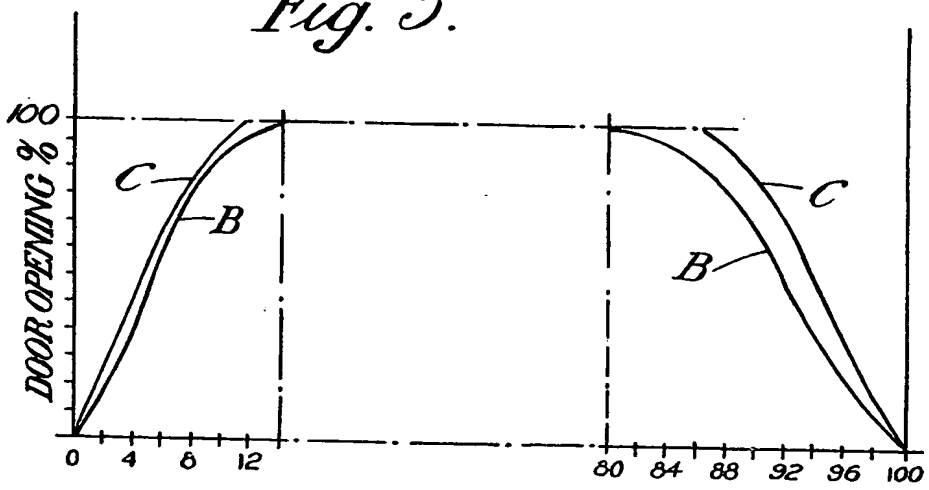


Fig. 4.

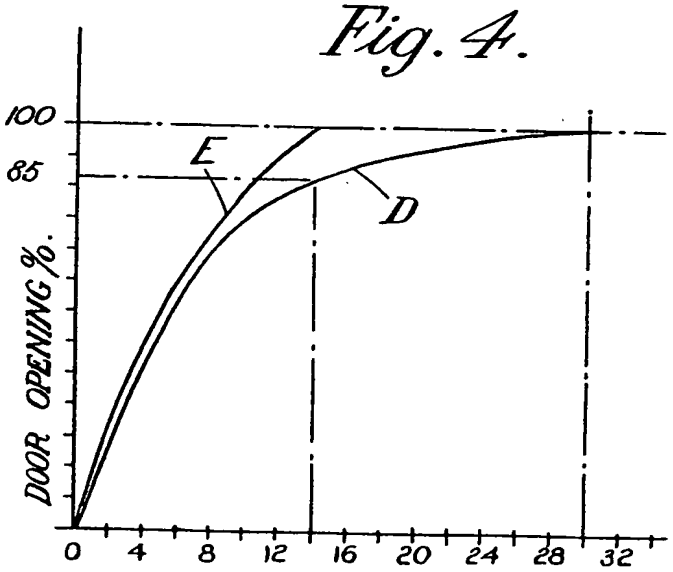


Fig. 5.

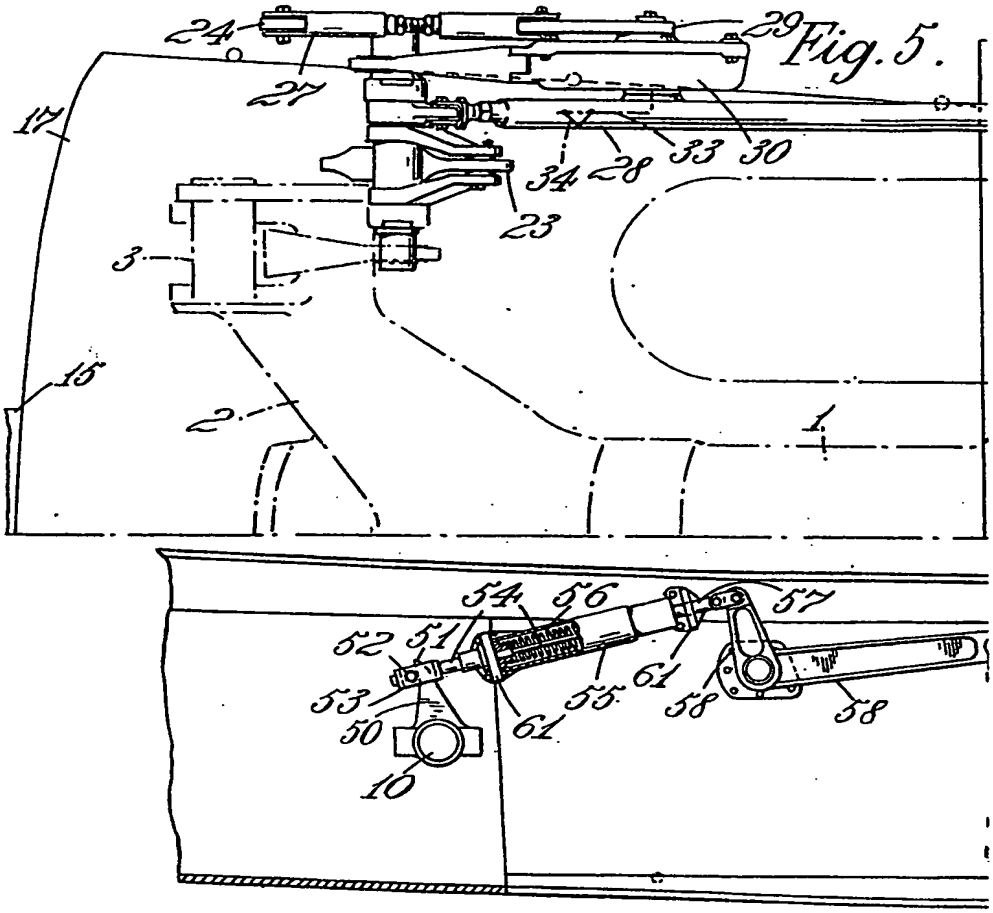
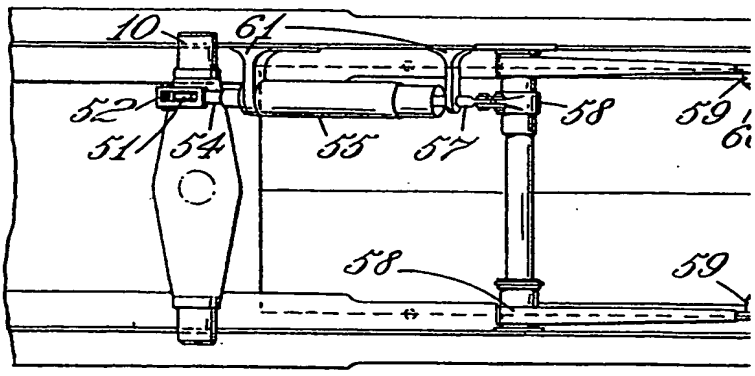

24
29
27
17
33
30
34
28
23
3
15
2
1
54
56
57
52
51
53
50
61
55
58
58
10

Fig. 7.


10
61
52
51
54
55
57
58
59
58
59

713,258 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig. 5.

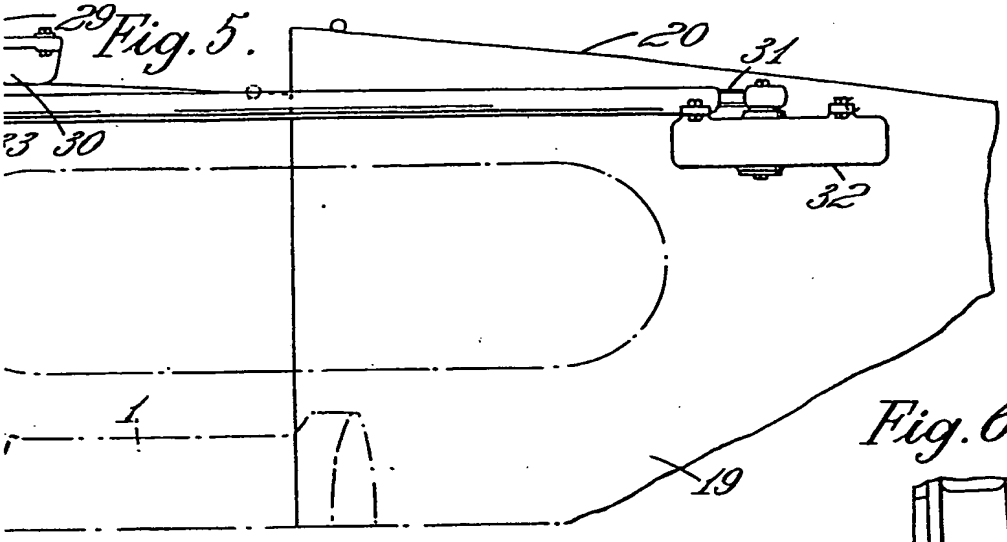
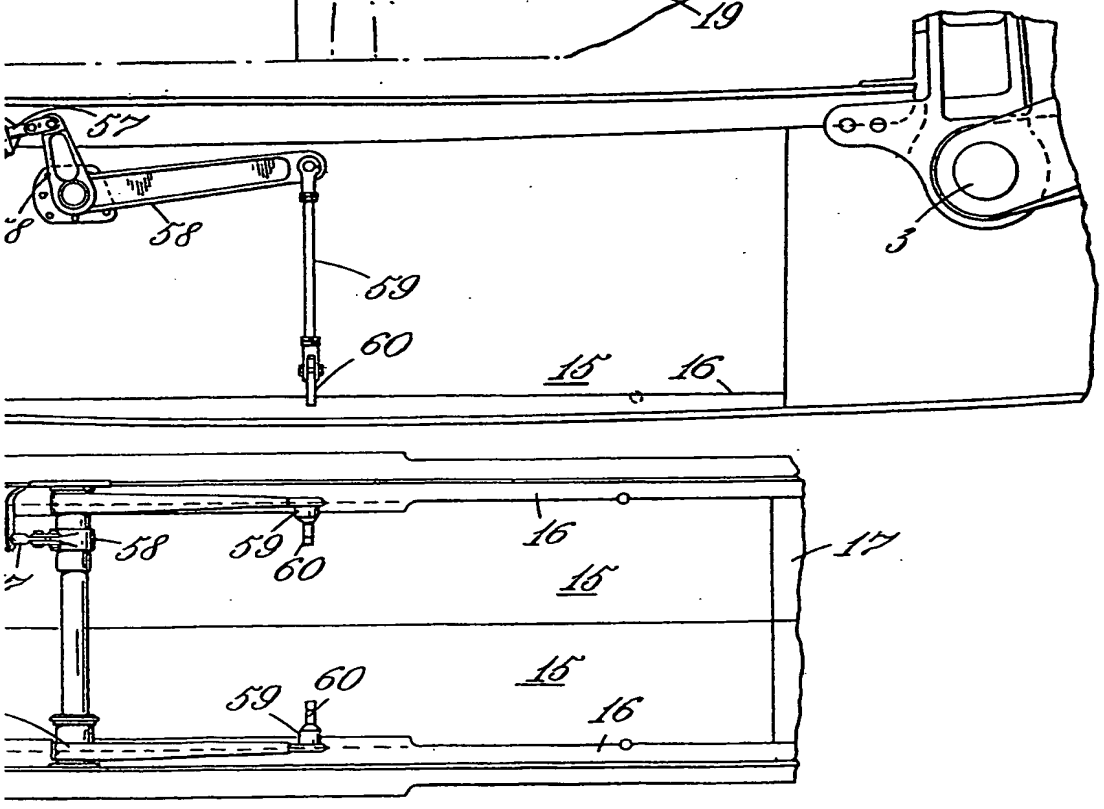


Fig. 6.



713,258 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale.

Fig. 5.

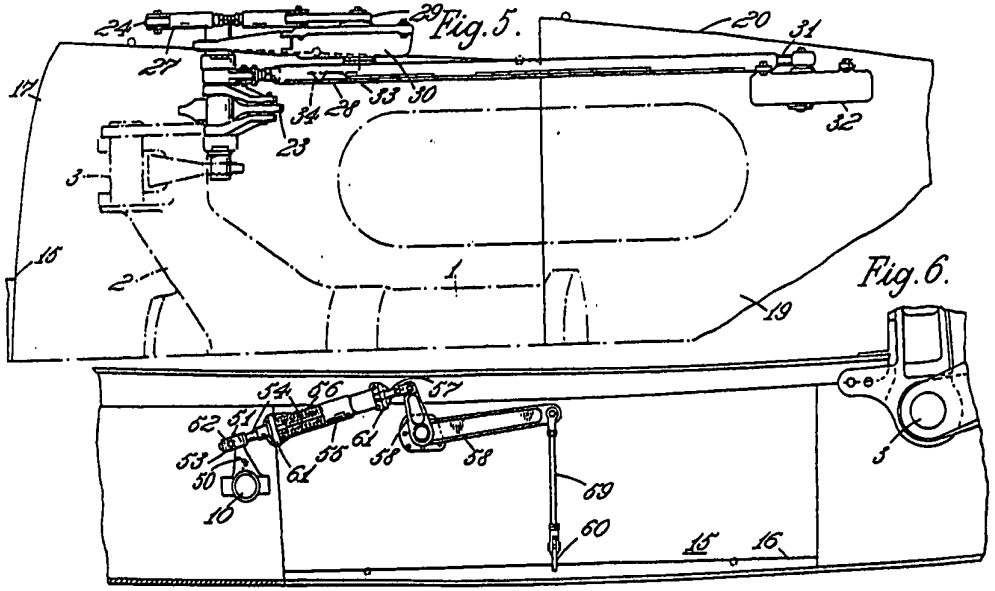
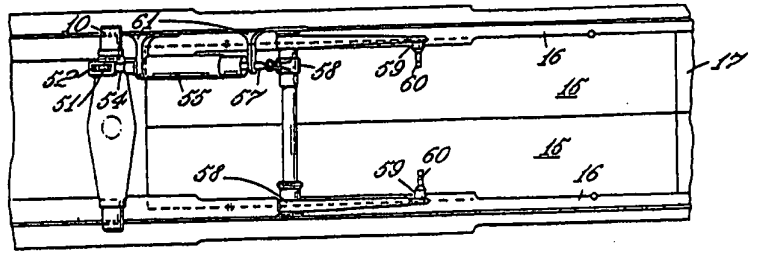


Fig. 6.

Fig. 7.



This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☑ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☑ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.